generating an infrared image to detect the presence of a purely subsurface kissing unbond defect, wherein the applying step includes disturbing the specimen using ultrasonic or acoustic energy.

REMARKS

Claims 1 and 18 have been amended. No claims have been cancelled and new claim 24 has been added. Accordingly, claims 1-24 remain under prosecution in this application.

35 USC §102; Devitt does not teach detecting "purely subsurface defects."

Claims 1, 3, 18, 19, 27, and 28 are rejected under 35 USC §102 (b) as being anticipated by Devitt et al (hereinafter Devitt). The techniques disclosed in Devitt relate **solely** to detecting surface cracks and do not relate to detecting ***purely subsurface cracks***. This limitation of the Devitt technique is found in various places throughout the specification, but it is most evident in column 7, lines 26-45 wherein a technique is disclosed by Devitt for detecting a "**subsurface**" defect. I have placed the word "subsurface" in quotes because Devitt's approach for detecting a subsurface defect is to stress the sample such that the subsurface defect migrates to the surface. Thereafter, the Devitt technique can be used for detecting, what has been made into a surface defect. Devitt's disclosed technique for detecting subsurface defects amounts to mechanically stressing the specimen until a subsurface defect becomes a surface defect. A subsurface defect that has been made to "surface" is no longer subsurface.

Devitt does not teach "exacerbating a thermal discontinuity caused by a purely subsurface kissing unbond defect."

In the Examiner's most recent action, the Examiner asserted that in our prior response, we argued a limitation which was not in the claims. Specifically, the Examiner asserted that we argued that "Devitt cannot detect [a] pure subsurface defect. . .". It is the undersigned's contention that claims 1 and 18 cannot be read any other way but to read the word "purely" in front of the word "subsurface." It is meaningless to talk about a subsurface defect that is not a "purely" subsurface defect. If the defect is not "purely" subsurface it must penetrate, in some way, the surface wherein it is a surface defect. The undersigned has

amended claims 1, 18 and 24 to include the word "purely" before all occurrences of the word "subsurface". The undersigned does not intend for this amendment, in any way, to change the scope of claims 1, 18, or 24 nor does the undersigned believe that such an amendment is necessary in order to distinguish the claimed invention over the art of record. It is the undersigned's contention that if a defect begins as a subsurface defect but after applying a force to the specimen, the subsurface defect migrates to the surface, it is no longer a subsurface defect and that any detection thereof is the detection of a surface defect and not a subsurface defect.

The undersigned also wishes to make of record that in column 7, lines 27-47, Devitt generally describes a method for applying stress to a sample and refers to Figure 1. In that description he states that the direction of the applied stresses are described by arrows 70 and 74. Arrow 70 depicts a force applied to the rear of the sample, which is not visible to the infrared camera, and arrows 74 are tensile stresses that pull opposing ends of the sample. If either of these forces (70, 74) is applied against a sample having a kissing unbond surface defect, the forces would act to close, rather than open, the subsurface kissing unbond defect (thereby lessening, not exacerbating, the thermal discontinuity). This is easily seen by viewing Figure 1 wherein a force directed along arrow 70 would push on the subsurface defect that is parallel to the sample surface, thus reducing the degree of thermal discontinuity posed by the defect. This same argument applies to tensile stress 74. A stress applied along the direction of 74 would elongate the sample in the direction of the stress thereby generating a compressive stress in the direction perpendicular to the application of the stress 74, again serving to, in effect, move the opposing faces of the kissing unbond defect closer together.

It is clearly evident from the disclosure of Devitt that Devitt's teaching is directed to detecting fatigue cracks that intersect the sample's surface and that are perpendicular, or generally perpendicular, to the sample surface. If these perpendicular cracks are tightly closed, application of mechanical stress (in the manner shown in Figure 1 of Devitt) may open them sufficiently to allow them to be detected using Devitt's method. The method of the present invention is designed to detect purely subsurface kissing unbond defects that are parallel, or generally parallel, to the sample surface. Application of a secondary stress (mechanical, acoustic, ultrasonic and the like) will, under the appropriate conditions, cause

such defects to interfere with the heat flow generated by the primary heating source. In a very real sense, Devitt's method and the method of the present invention are essentially "orthogonal." That is to say, Devitt's method is incapable of detecting a subsurface kissing unbond defect while our method is probably ineffective or marginally effective for detecting a generally perpendicular surface crack.

The Devitt technique is totally incapable of detecting purely subsurface kissing unbond defects. Devitt's technique assumes that a crack in the specimen is either on the surface of the specimen (or can be brought to the surface of the specimen by exertion of contorting the specimen). Devitt also assumes that the crack is a small, empty cavity that absorbs radiation at one wave length and then re-radiates the energy in a second wave length (preferably the infrared spectrum) where it can be detected by using an infrared camera. This is generally explained in column 6, line 53 of Devitt. Presumably the crack will appear hotter than its surrounding areas after excitation. However, the Devitt method will not work in some very common non-destructive inspection applications where purely subsurface kissing unbond defects are encountered, particularly where the crack is not an empty cavity. The method of the present invention is not thwarted by these applications. For example, in an adhesively bonded structure where a soft or flexible sealant is used in conjunction with rivets or other mechanical fasteners (such technique is commonly used on aircraft fuselage lap-seams to prevent moisture from seeping in), the method of the present invention may open a weakly bonded area where the fastener is not functioning properly, yet the sealant remains in place between the faces of the kissing unbond defect. Our method would detect such a disbond, as the density of the sealant would be reduced by the opening of the disbond. However, if such a disbond could be exposed to the surface, the presence of the sealer would obstruct Devitt's incident radiation and again the thermal properties of the sealant itself would determine whether the temperature at the exposed crack was higher, lower or the same as the surrounding areas.

In another example relating to composite materials, where pure subsurface kissing unbond defects (such as delaminations) are of extreme interest, a subsurface defect may occur and as a result the fibers that permeate the material may become unbonded from the surrounding matrix and remain in the area that is open by the application of an external stress.

The presence of fibers does not effect the method of the present invention, but would scatter the incident radiation, and block the exiting radiation in the Devitt method.

The undersigned believes that claims 1 and 18 and their respective dependent claims are in condition for allowance.

Claim 24 has been added. Claim 24 includes the feature "wherein the applying step includes disturbing the specimen using ultrasonic or acoustic energy." None of the references of record teach or suggest the use of ultrasonic or acoustic energy for "exacerbating a thermal discontinuity caused by a subsurface defect. . ." and accordingly the undersigned believes that for this reason, claim 24 is allowable.

Respectfully submitted,

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MARKED UP VERSION OF ALL AMENDED CLAIMS

1. (Twice Amended) A method for [non-destructive evaluation of a specimen,]non-destructively evaluating a specimen for the presence of kissing unbond defects, comprising the steps of:

heating the specimen;

applying a force to the specimen, wherein the magnitude of the force is sufficient to exacerbate a thermal discontinuity caused by a purely subsurface kissing unbond defect of said specimen; and

generating an infrared image to detect the presence of a purely subsurface kissing unbond defect .

18. (Twice Amended) An apparatus for [non-destructive evaluation of a specimen,]non-destructively evaluating a specimen for the presence of kissing unbond defects comprising:

a heat-sensitive image generator that generates thermographic images;

a heater that increases the temperature of the specimen; and

means for applying a force to the specimen, wherein the applying means changes at least one dimension of a purely subsurface kissing unbond defect in the specimen to create a thermal discontinuity.